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Revised Claims

1. A comprehensive gas processor for removing the moisture and recovering the higher hydrocarbons (i.e., C_2^+) therein either on-situ in a gas field or in a plant comprising:
 - (a) an integrated gas processor comprising two sections working on a hybrid process, i.e., an integration of two different processes within a single casing:
 - i) a refrigeration-dehydration section working on refrigeration process wherein the inlet gas contacts with a counter-flowing stream of dispersed cold heat-transport medium containing a non- or low-volatile hydrate inhibitor with boiling point higher than 180°C and the moisture of said gas is condensed and removed with the cold heat-transport medium; and
 - ii) an absorption section working on low-temperature absorption process wherein the dehydrated gas contacts with a counter-flowing stream of dispersed liquid absorbent with a hydrocarbon gas solubility higher than 20 scf/gal wherein the higher hydrocarbons (i.e., C_2^+) are absorbed;
 - (b) a heat-transport medium cooler comprising a pre-cooling stage and a deep-cooling stage wherein in said pre-cooling stage said heat-transport medium is pre-cooled with the cold outlet gas left said integrated gas processor and in said deep-cooling stage the medium is deep-cooled with the refrigerant provided with a refrigerator;
 - (c) an absorbent cooler comprising a pre-cooling stage and a deep-cooling stage wherein in said pre-cooling stage said recycling absorbent is pre-cooled with the cold outlet absorbent left said integrated gas processor and in said deep-cooling stage the absorbent is deep-cooled with the refrigerant provided with a refrigerator;
 - (d) a fractional distiller for separating the absorbed higher hydrocarbons as a product from the outlet absorbent left said integrated gas processor and then the separated absorbent is recycled back to said integrated gas processor;
 - (e) an inhibitor regenerator for concentrating the low-volatile hydrate inhibitor to be recycled and discharging the wastewater;
 - (f) a refrigerator for providing the refrigerant to said deep-cooling stages of said heat-transport

- a1* medium cooler and said absorbent cooler;
- (g) a pipeline for delivering the recovered higher hydrocarbons; and
 - (h) a gas inlet pipeline and a pipeline for delivering the processed gas.
2. A comprehensive gas processor of claim 1 wherein the dehydration section of said integrated processor and its accessories (comprising said heat-transport medium cooler, said inhibitor regenerator, said refrigerator, and said gas inlet pipeline and a pipeline for delivering the processed gas) are operated independently as a gas dehydrator without incorporating the absorption section.
 3. A comprehensive gas processor of claim 1 wherein said heat-transport medium is an aqueous solution of calcium chloride or other ionizing salts and the regeneration rate of said solution is less than 5 liter per kg of wastewater to be discharged.
 4. A comprehensive gas processor of claim 1 wherein said heat-transport medium is an aqueous solution of ethylene glycol or other organic compounds with boiling points higher than 180°C and the regeneration rate of said solution is less than 5 liter per kg of wastewater discharged.
 5. A comprehensive gas processor of claim 1 wherein said absorbent is heavy oil (i.e., hydrocarbon mixture with molecular weight higher than 100) or other organic compounds with hydrocarbon gas solubility higher than 20scf/gal liquid.
 6. A comprehensive gas processor of claim 1 when working on inlet gas pressure greater than 5.0 MPa wherein said refrigerant to said deep-cooling stages of said heat-transport medium cooler and said absorbent cooler is provided with a gas expansion device when the inlet gas pressure is greater than 5.0 MPa.

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- 7th* A gas expansion device of claim 6 wherein said expansion device is a triple-sectional free-piston gas expander-compressor-booster comprising:
- (a) a gas expansion cylinder and a gas compression cylinder;
 - (b) a co-shaft gas expansion piston and gas compression piston; and
 - (c) a co-shaft gas-fueled booster piston-engine providing supplemental power for compressing said expanded gas to the required delivery pipeline pressure.